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Home Media and Children's Achievement and Behavior

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Abstract

This study provides a national picture of the time American 6–12 year olds spent playing video games, using the computer, and watching television at home in 1997 and 2003 and the association of early use with their achievement and behavior as adolescents. Girls benefited from computers more than boys and Black children's achievement benefited more from greater computer use than did that of White children. Greater computer use in middle childhood was associated with increased achievement for White and Black girls and Black boys, but not White boys. Greater computer play was also associated with a lower risk of becoming socially isolated among girls. Computer use does not crowd out positive learning-related activities, whereas video game playing does. Consequently, increased video game play had both positive and negative associations with the achievement of girls but not boys. For boys, increased video game play was linked to increased aggressive behavior problems.

Recent reports emphasize the pervasive influence of the media on children's lives (Roberts, Foehr & Rideout, 2005). In 1950, only about 9% of American families owned a television set, but by the early 1980s, when the first systematic examinations of children's time began, 98% of American families owned one (Anderson, Huston, Schmitt & Linebarger, 2001; Andreasen, 1994). Since then, there has been a dramatic increase in communication technologies available to the public, all of which are subsumed under the term, *media*. Although they may not be new to many adults — three quarters of children lived in a home with a computer in 1999 — the usage by children of home computers and video games, what are called *new media*, is relatively recent. In 1999, fewer than half (47%) of children 8 to 18 used a computer during the previous day, rising to 54% by 2004 (Roberts et al., 2005). In 1999, children 8 to 18 spent only 27 minutes in an average day using the computer for recreation at home; that had more than doubled to just over 1 hour by 2004. Another major change was in access to the Internet; the proportion of children living in a home with Internet access rose from 47% to 74% between 1999 and 2004 (Roberts et al., 2005).

As a result of the rapid diffusion of new technologies, research on their effects has been slow to catch up. A recent critique of a leading textbook on children and the media pointed to the lack of systematic information over time on children's use of television, computers, and other media (Sotirovic, 2005). Comparing children's media use over time is difficult because research reports do not use comparable samples of children and often do not break out results for age groups. In addition, they permit overlap in use. Not adjusting media time for simultaneous use leads to exaggerated estimates of total time spent with media, implying a day of more than 24 hours. Most studies fail to include reliable measures of what else children are doing and what tradeoffs between activities are made. Finally, few studies focus on middle childhood, an important period in establishing long-term media habits, one in which large changes in media use are occurring, and one in which the family context is critical.

The present research is the first to examine the implications for children of increased exposure to media at home using nationally representative data. It reports changes in the past decade in the utilization of computers, video games, and television in comparison with other activities among children in middle childhood. Second, it examines how the utilization of new media is

tied to other aspects of children's lives. The introduction of new technologies may change children's television viewing, alter study habits, and change leisure time pursuits and sleep patterns. Using a widely accepted methodology that ensures that total time not exceed 24 hours in a day and that obtains information not only on media, but also on other activities, it examines the association of new media time with playing, studying, reading, sleeping, sports, television viewing, and outdoor time. Third, this research examines the consequences of new media use at ages 6–12 for children's achievement and behavior in adolescence six years later.

Theory and Review of Literature

Theory about the Effects of Media on Children

The introduction of any new form of media technology leads to a debate about its implications, especially if children have access. Critics of computer use by children focus on two concerns. First, computer use per se may not contribute to development because children learn through creative and imaginative play, which require manipulating the physical environment (Cordes & Miller, 2000; Healy, 1998; Kelly, 2000; Miller, 2005). Second, computers may displace traditional learning-related activities such as reading, studying, and nonscreen play that are essential for healthy child development (Van Evra, 2004). However, others argue that media may benefit children. Computer literacy has been touted as the primary avenue to success in the 21st century (Attewell, 2001). Learning how to use computers has potential advantages; most adult jobs require at least minimal computer literacy and many jobs require more advanced computer skills. Playing educational games and searching for information on the Internet can improve children's academic and computer skills.

Theory provides several avenues for potential consequences of media exposure. The first pathway is *social or observational learning* (Bandura, 1969; Bandura, 1976; Bandura, 2002). Media can add to development if they provide new information or stimulate children's learning. Children have been found to gain knowledge about the world and to learn directly and indirectly from media about how to solve problems (Fisch, 2004; Van Evra, 2004). Research using brain imaging documents areas of the brain that are activated in viewing television, areas associated with memory, face and object recognition, attention, intention, perception, and arousal in threat situations (Anderson, Fite, Petrovich & Hirsch, 2006). Children also learn how to find information and to manipulate media devices, skills that transcend content.

Research has failed to prove a strong link between computer use and child learning. One study found that children with a home computer reported higher grades than those without a home computer (Rocheleau, 1995); however, other studies found no effects of home computer use on achievement (Subrahmanyam, Greenfield, Kraut & Gross, 2001). There is one exception; drill and practice programs for learning specific skills have been linked to the skills targeted (Coley, Cradler & Engle, 1997). Unfortunately, there are only a few studies and the outcomes are mostly self-reported. Another major limitation is that the research to date has failed to specify the use of the computer – for playing games, studying, or communication.

Research has shown that educational television viewing boosts early literacy and reading habits (Anderson et al., 2001; Fisch & Truglio, 2001). Besides the benefits that have been found for very young children, educational programs have also been shown to have raised motivation to read, increased knowledge of current events, and improved problem-solving skills in math and science among older children (Fisch, 2004). Given the record of learning from educational television programming and given the highly interactive nature of games, educational computer or video games have the same or greater potential for learning. Game playing has potentially positive effects such as improved motor skills, spatial skills, iconic skills (the ability to read images), practice in logic, problem solving, visual attention, and active learning, practice, and discovery leading to mastery (Gee, 2003; Van Evra, 2004). Research has corroborated the

effectiveness of game playing for improving spatial skills and visual/perceptual skills, such as improving hand-eye coordination (Lee & Huston, 2003; Subrahmanyam & Greenfield, 1994). Although the emphasis has been on visual and spatial skills, children may seek and read on-line tips for improving their game strategies and skills. Many games require the same skills that are tested in nonverbal IQ tests (Subrahmanyam et al., 2001) plus a high level of involvement and concentration (Lieberman, 2006).

A second theory, *cultivation theory*, argues that media content affects viewers' beliefs about the world, and, consequently, alters their behavior (Gerbner, Gross, Morgan, Signorielli & Shanahan, 2002). For example, exposure to violent media leads to a belief that aggression can resolve problems with no adverse effects. Under this theory, more time exposed to violent games would lead to more aggressive behavior (Anderson et al., 2001). The gender-stereotyped characteristics and behaviors of game characters reinforce traditional notions of male and female roles (Alloway & Gillbert, 1998; Gerbner et al., 2002; Ivory, 2006), which may lead to lower self-esteem among female players (Lee & Peng, 2006; Cesarone, 1998).

Although educational, fantasy, and sports games exist, even those with the broadest age rating can contain mild violence (Anderson, 2002). The pervasiveness of violent and aggressive video games suggests that more exposure means more exposure to violence. A meta-analysis of 35 research reports concluded that exposure to violent games increased later aggressive behavior for both boys and girls (Anderson & Bushman, 2001). Violent game play was associated with aggressive thoughts, aggressive affect, and physiological arousal, with suppression of affective areas of the brain responsible for positive emotions (Weber, Ritterfeld & Mathiak, 2006). Exposure was more harmful for youth who were more aggressive to begin with (Anderson, 2002; Van Evra, 2004). If computers are used to play games, the same outcomes are possible.

Use and motivation theory argues that the impact of media depends upon the uses to which media are put, the motivations (learning, entertainment), and the individual abilities and dispositions of the user (Rubin, 2002; Huston, McLoyd & Garcia Coll, 1994). Thus, the context and selectivity of media use need to be taken into account. Young children are more susceptible to influence because their attitudes, beliefs, ideas, and knowledge are developing rapidly and they absorb information from every source. They cannot be expected to have the same sophistication of understanding as do older children or adults. Toddlers, for example, have been shown to learn less quickly and consistently from behaviors modeled on a television screen than those in real life (Schmitt & Anderson, 2002). Computer use shifts with age; younger children play games whereas older children spend more time accessing web sites and communicating by e-mail and instant messages (Roberts et al., 2005). Similarly, video game play changes with age. Educational games decline and sensorimotor games increase (Wright et al., 2001b). Beginning in about 5th grade, the motivation for video game playing is challenge and fantasy. As children age into junior high school, social motivation comes into play, including interaction around games, competition, and sharing of strategies (Van Evra, 2004).

Media use is highly gendered. Although there are few differences in television viewing or computer use, boys devote more time to video game play than girls. An important aspect of game playing, both video game and computer game play, is the reinforcement of gender-differentiated peer group culture (Sefton-Green, 1998). Games may provide opportunities to compete and cooperate around game playing, thus facilitating social interaction. Male talk often centers on discussions of games and problem-solving (Vered, 1998). Because in most games the main character is male and the activities are also male-oriented (von Salisch, Oppl & Kristen, 2006), it should not be surprising that boys develop a greater interest in and expertise in video games and spend more time than girls playing such games (Roberts et al., 2005). Boys prefer more aggressive games whereas girls prefer well-developed characters and stories and bring different expectations and norms to the play setting, eschewing yelling and aggression

(Vered, 1998). Because of the different amount and type of video game play by boys and girls, their behaviors may be differentially influenced (Subrahmanyam & Greenfield, 1994). Greater use of educational game play may give girls' achievement a boost (von Salisch et al., 2006). For boys, game playing could lead to involvement in supportive peer groups rather than to isolation. This may be especially the case for video games, which provide multiple controllers, compared with computer games that have only one mouse. For girls, game playing could lead to greater social isolation, especially if they play games on the computer rather than on hand-held consoles. For both genders, greater use of the computer for communications such as e-mail and instant messaging may lead to greater social involvement.

Research shows African Americans and Hispanics to have greater overall media exposure; however, this is due to the latter's heavier time spent watching television. Substantial racial/ethnic differences in home computer access have been documented, with African American and Hispanic 2–7-year-olds averaging only 60% of the usage of White children of the same age (Roberts, Foehr, Rideout & Brodie, 1999). Because of their lower access to other learning-related resources, children from minority families may benefit more from having access to a computer at home than children from majority families (Wright et al., 2001). As children enter school, learning resources increase, but most time is still spent at home. Black children are also disadvantaged at school; children living in zip codes with an annual median income below $25,000, more likely to be the residential location of Black and Hispanic families, had about one-quarter of the exposure to computers of those with incomes over $40,000 (Roberts et al., 1999). African American boys may not experience the same peer group culture that focuses on video games as do White boys. Because most of the early media research was conducted using White middle-class samples in the Midwest, we have less information about differential effects of media use among different race/ethnic groups. Thus, it is important to investigate whether there are differential effects of computer and video game use across racial/ethnic groups separate from income. That is, the effect of media use on reading and math scores and behavior may vary by race, independent of income and education (Attewell & Battle, 1999).

Parental characteristics and behavior may moderate the effects of media (Nikken & Jansz, 2006) because children are dependent upon them for both media and control over their subsequent behavior. Children whose parents have less education and whose families have lower incomes have been shown to have less access to computers than their more advantaged peers (Attewell, Suazo-Garcia & Battle, 2003; Roberts et al., 1999; Roberts et al., 2005).

In sum, greater exposure to media facilitates learning the what (content) and how (technical skills) of the information displayed. It also promotes socialization into peer cultures. Media's effects are dependent upon the context in which their use takes place and characteristics of child and family (e.g., age, gender, and race) (Fisch, 2004). In addition, whether media are used for game play, study, or for communication may influence outcomes.

Consequences can also occur because media used for entertainment or social activities may displace activities such as studying, reading, physically active sports and outdoor activities, nonscreen play, and sleep, which positively contribute to health and development. Thus the fourth theory, *displacement theory*, is that media use displaces important developmental activities (Anderson et al., 2001; Neuman, 1995). A negative association is expected; because time is limited, if you do more of one type of activity you have less time for other activities. *Which activities are displaced and by how much is the important issue.* There are at least three possible mechanisms of displacement: first, new media displace functionally equivalent activities (e.g., video games displace computer games); second, new media replace similar but less structured activities (e.g., computer play displaces nonscreen play or outdoor activities); and, third, new media displace less satisfying activities or activities with smaller benefits at the margin (e.g., computer games displace studying or sleeping) (Neuman, 1995).

One of the major concerns of developmental psychologists is that the use of computers and video games could reduce children's social involvement and increase isolation. The limited research available has been unable to document a negative association of computer use with social behavior, perhaps because some social interactions, such as communication with friends, are facilitated by computers (Subrahmanyam et al., 2001). A recent study that provided home computers and internet access to families who did not previously have such access found significant short-term (one-year) declines in social involvement but these effects weakened after the first year (Subrahmanyam et al., 2001). Research has found that increased computer and video game use altered interaction patterns as families incorporated media into their lives (Mitchell, 1985; Nikken & Jansz, 2006), but there was no overall negative impact. Several studies found greater computer use by children associated with watching less television (Neuman, 1995; Stanger, 1998; Wright et al., 2001) and another found greater computer use associated with less time in sports and outdoor activities (Attewell et al., 2003).

Small amounts of media use are unlikely to indirectly affect achievement and behavior because they do not displace much other activity time. Thus, a curvilinear effects hypothesis is reasonable. That is, although low to moderate usage could promote positive achievement and behavior through social learning, *heavy usage* could displace time spent studying, reading, playing, and interacting with peers, and this may lead to reduced achievement and increased social isolation, low self-esteem, and inability to relate to others (Calvert, 2002; Lee & Peng, 2006; Subrahmanyam et al., 2001). One study found low (but not high) computer use to be associated with more time spent reading and greater letter-word recognition, reading comprehension, and mathematical calculation achievement test scores among elementary school children (Attewell et al., 2003). However, another study found heavy computer use to be associated with greater achievement by adolescents (Rocheleau, 1995).

Finally, video game play may displace the typical activities in which children engage, leading to social isolation or overdependence on games (Kelly, 2000). More time in video games is likely to interfere both with more accepted learning-related activities and with physical and social activities such as sports and informal outdoor activities. One study found video game play leading to less prosocial behavior such as donating to others (Chambers & Ascione, 1987; Van Evra, 2004). Because no prior research has examined the displacement effect and there is little known about its association with achievement, more systematic research is needed.

Are Media Effects Causal?

Does media use reduce participation in other activities, does having fewer other activities lead to increased media use, or does something else both reduce other activities and increase media use? Children and their parents choose how to spend their time. Television and other media serve as entertainment, a way for families to spend time together, and as a source of educational, social, and cultural information (Dempsey, 2005; Jordan, 2004). Outside forces may influence families to take up new media and associated lifestyles and result in changes in children's reading, studying, and leisure activity patterns. Any association between media patterns and reading, studying, and socializing of children may be spurious. Therefore, it is important to control for factors that may influence both media use and children's other activities, including socioeconomic status, maternal education and reading ability, race/ethnicity, number of parents, maternal employment, and number of children. Unlike other behaviors, displacement effects cannot be examined over time because normal development-related activities change as children move into adolescence. At one point in time, some kinds of activities are associated and others are not for individual children, controlling for confounding variables. Negatively associated activities are incompatible; positively associated activities or those with no association are compatible.

Because media use is selective, it is also important to control for initial levels of achievement and behavior in examining outcomes over time. If aggressive children attend to more violent media than less aggressive children; media use may have no additional impact. Additionally, parents who fear negative effects may intervene in advance, thus limiting potential harm (Nikken & Jansz, 2006). A more rigorous test of causality is whether a *change* in media use over time is associated with *change* in behavior or achievement for that same child.

Hypotheses

Displacement of healthy activities—The first hypothesis explored here, from displacement theory, is that the more time spent on media, the less time spent in all other activities considered to be valuable for children's health and well-being, including reading for pleasure, studying, nonscreen playing, sleeping, and playing sports or spending time outdoors. If media displace functional equivalents, then new media should displace old (television), computer studying should displace noncomputer studying, and video/computer game play should displace each other. If structured displace less structured activities, then computer or video game play would displace outdoor activities, reading, nonscreen play, and sleep. If pleasure is the issue, then computer or video game play would replace noncomputer studying.

Observational learning—The second hypothesis is that computer use will facilitate learning such that children who use a home computer for studying, sending e-mail or text messages, or exploring the Internet will demonstrate higher vocabulary, reading, and problem-solving test scores. Similarly, greater video or computer game play will be associated with improved test scores, particularly on problem solving. However, the benefits of computer game and video game play are likely to accrue at low or moderate levels rather than at higher levels. Greater television use is expected to be associated with higher achievement if it promotes learning but lower achievement if it displaces studying and reading. Prediction is weak because this study is unable to distinguish educational from entertainment viewing.

Cultivation theory: Behavior problems—The third hypothesis is that greater computer game and video game play will be associated with more behavior problems such as social withdrawal. High video game play will also be associated with more aggressive behavior problems because of its violent content. Finally, greater computer use for communications such as e-mail, instant messaging, and Internet use will be associated with fewer behavior problems because of its positive social networking function.

Use and motivation theory—The fourth hypothesis is that the effects of computer and video game use on achievement and behavior will differ by the race/ethnicity, age, and gender of the child. For example, Black children's achievement is expected to benefit from computer use more than that of their White peers. Younger children may be more influenced by computers and games than older children. Finally, because of their greater selection of violent games and greater salience to their peer group, boys' behavior may be more strongly linked to their computer and video game use, whereas girls' achievement may be influenced more by variation in computer and video game use because of their lower average usage.

Methods

Data

The study sample consisted of 6–12-year-old children living with their mothers. The data were drawn from the Panel Study of Income Dynamics (PSID), a 30-year longitudinal survey of a representative sample of U.S. men, women, children, and their families. In 1997 the PSID added a refresher sample of immigrants to the United States. Also in 1997, with funding from the National Institute of Child Health and Human Development, data were collected on up to

two randomly-selected 0 to 12-year-old children of PSID respondents both from the primary caregivers and from the children themselves, the Child Development Supplement (CDS). The first CDS survey period began in March 1997 and ended in early December 1997 with a break from mid-June through August; thus, the study took place only during the spring and fall. Interviews were completed with 3,563 children in 2,380 child households with a response rate of 88%. From fall 2002 through spring 2003, the participants in the 1997 Child Development Supplement were recontacted and another supplement administered. The total potential number of children eligible in 2002–03 was 3,191, of whom 2,907, 91%, participated in the second Child Development supplement. When weights are used, the PSID is representative of U.S. individuals and their families (Fitzgerald, Gottschalk & Moffitt, 1998a).

For the descriptive analysis of activities and for the displacement analysis, the sample used in the present study consisted of 1,951 boys and girls between 6 and 12 years of age in 1997, of whom 1,871 lived with their mothers, and 1,607 boys and girls who were age 6 to 12 in 2003, of whom 1,581 were living with their mothers. The 1997 and 2003 Child Development Supplements collected complete time diaries for one weekday and one weekend day for 1,448 (77 %) of the 1,871 children aged 6 to 12 in 1997 and 1,317 (83%) of the 1,581 children aged 6 to 12 in 2003 living with their mothers. Comparisons between children who provided a diary and those who did not showed no significant differences on demographic characteristics.

For the outcome analysis, a longitudinal sample of children 6 to 12 years of age in 1997 who were reinterviewed in 2003 when they were between 12 and 18 years of age was created. Of the 1,448 children interviewed in 1997 and eligible, 1,226 were reinterviewed in 2003.

Measures

Time Use—The time diary, which was interviewer-administered either to the parent or to the parent and child, asked about the child's flow of activities over a 24-hour period beginning at midnight of the randomly designated day. The questions asked the primary activity that was going on at that time, when it began and ended, and whether any other activity was taking place. The full instrument can be seen at (http://psidonline.isr.umich.edu/CDS/TDqnaires.html). Activities need to occur regularly to be reliably reported in a diary (Juster & Stafford, 1985). The activities selected occur daily (sleeping, nonscreen play, watching television) or several times per week (studying, reading, video game playing, computer use, outdoor activities, and sports).

Professionally trained staff employed by the data collection organization coded the data to a level of reliability exceeding 90 percent. Because of extensive follow-up and editing, diaries were complete. Time spent traveling for the purpose of engaging in a specific activity was included in that category but two children who were traveling throughout their two diary days were excluded. Secondary activities were not included in the analysis presented here. This ensured that time added to 24 hours, making estimates of children's activities exhaustive, mutually exclusive, and additive. Almost no secondary computer or video game use was reported. The same analyses were run using total television use, primary plus secondary. The results and implications were the same as reported for primary time.

For comparison across time, the primary activities of children were classified into the 18 major categories used by Timmer and colleagues in the early 1980s (Timmer, et al., 1985) and by Hofferth & Sandberg in 2001 (Hofferth & Sandberg, 2001a; Hofferth & Sandberg, 2001b). Computer time was separated from its original categories such as play, study, and hobbies. Because it could be educational or recreational, computer use was further divided into three categories: playing games, studying, and computer communications. The latter includes activities such as Internet searching, accessing web sites, e-mailing, and instant messaging. Electronic video game time (such as on Game Boy and other hand-held video game devices)

was also separated from the larger *play* category; the remaining noncomputer, nonvideo-game play is referred to here as *nonscreen play*. This analysis focuses upon ten common activities among children: watching television, nonscreen play, playing video games, playing on the computer, studying using the computer, computer communications, noncomputer studying, reading for pleasure, playing sports, informal outdoor activities, and sleeping. Time spent attending school was used to adjust for the potential amount of nonschool leisure time available to a child. Specific codes used to define each of these categories in 1997 and 2003 are available from the author. The total time children spend in an activity is a function of the proportion who engage in the activity and the time participants spend in it. An estimate of weekly time was computed by summing weekday time (including those who do not participate and have zero time) multiplied by 5 and weekend day time multiplied by 2.

As an alternative measure of time in a media activity, time spent on the computer and playing video games was divided into four categories – no use, low use (under the 25th percentile), moderate use (25th to under the 75th percentile among users), and high use (75th percentile and up). To illustrate, the 25th percentile for computer users was 1.6 hours, for video game users it was 2 hours. The 75th percentile for computer users was 6 hours and for video game users it was 7.2 hours. The results for low and moderate use were similar, so they were combined. Because everyone watched television, viewing hours were divided into low (lowest quartile – under 6.7 hours), moderate (25th percentile to 75th percentile – 6.75 to under 18.8 hours per week), and high (75th percentile and up – 18.8 hours plus).

Children's Behavior and Achievement—Children's *socioemotional adjustment* was measured by the Behavior Problems Index, a parent-reported measure of the incidence and severity of child behavior problems using 30 items originally drawn from the Achenbach scale (Peterson & Zill, 1986). This same scale has been used in the Child-Mother study of the 1979 National Longitudinal Survey of Youth since 1986 (Rogers, Parcel & Menaghan, 1991). Using factor analysis with oblique rotation to permit interfactor correlation, two sets of factor scores, one with 16 items measuring withdrawn or distressed behavior (fearful, anxious, sad, withdrawn), called "internalizing," and one with 14 items measuring aggressive and impulsive behavior (disobedient, argumentative, moody, destructive), called "externalizing," were created. The correlation between these two factors was .51. For our longitudinal sample of 1,226 children whose families were interviewed in both 1997 and in 2003, the alphas were . 88 for externalizing and .86 for internalizing each year. The alpha for the total behavior problems scale was .92. After deleting 152 cases missing data on controls, 1,074 boys and girls were included in the behavior problems analysis.

Three subtests of the Woodcock-Johnson Revised Test of Basic Achievement measured *cognitive achievement*: letter-word identification, a test of children's ability to identify and respond to letters and words; passage comprehension, a test which measures reading comprehension skills; and applied problems, a test of skill in analyzing and solving practical numerical problems (Woodcock & Mather, 1989). These were administered in the child's home in 1997 and 2003 by trained interviewers using materials prepared and distributed by the publisher of the test. Mothers were also administered the passage comprehension test. Children had to have a test score in both years to be included. Scores were calculated based on national norms that were age-standardized with a mean of 100 and a standard deviation of 15. Not all eligible children were assessed; therefore, sample sizes were smaller for achievement than for behavior problems. A significantly higher proportion of the children who were not assessed were White because most of such families were in the Midwest, far from population centers where interviewing teams were located. Children who were not assessed were also slightly less likely to live with two parents. Race and number of parents were controlled in the analysis. There were no significant differences on other variables, including media use and other activities. The results suggest that the exclusion of these children from the analysis of

achievement did not bias the representativeness of the sample. The sample size was 880 for passage comprehension, 901 for the letter-word test, and 898 for applied problems.

Control Variables—Besides the overall analyses by gender, age, and race/ethnicity, this study examined media use controlling for key demographic characteristics of the family: maternal education (no college, some college, college degree), total family income or the ratio of family income to the poverty line, maternal employment (employed versus not employed), family structure (1 versus 2 parents), and family size (1 or 2 versus 3 or more children). Controls included season of interview (fall=September through November, winter=December through February, spring = March through June) and warm vs. not warm state. All the definitions were consistent across the two waves of data except that of maternal employment. In 1997, maternal employment was defined as ever-employed in the previous year, whereas, in 2003, maternal employment was defined as employed at the time of the survey. The core PSID wave that collected employment information was conducted in 2001 and not in 2002; employment at the survey date was deemed to be a better indicator than employment more than a year prior to the survey. Although included in the displacement analysis, because it had substantial missing data and was never related to any of the child outcomes in the preliminary analyses, maternal employment was dropped in the longitudinal analyses of child achievement and behavior. The difference analysis included a set of dummy variables for whether a change in family structure had occurred (one parent in both years, one parent in 1997 and two in 2003, two parents in 1997 and one in 2003, and two parents both years — the comparison group).

Analysis Plan

Displacement Analysis using Pooled Sample of Children 6–12—For the displacement analysis, the sample of children 6–12 in 1997 was pooled with the sample 6–12 in 2003, a total of 2,765 children. After deleting 203 cases missing on either date of interview or on maternal employment, there were 1,323 children 6–12 in 1997 and 1,239 6–12 in 2003, a total of 2,562 children in the pooled multivariate analysis. All analyses were weighted using population weights provided by the PSID-CDS adjusting for the original probability of selection and for attrition, which were then normalized on the sample. Robust standard errors were computed using Stata to adjust for clustering of children within families and across years. A dummy variable was included to control for the data collection year.

Instead of dividing time into categories (Attewell et al., 2003) or using ordinary least squares regression (OLS) (Vandewater, Bickham & Lee, 2006), the analyses of amount of time spent in the activity were based upon Tobit regression models. These models adjust for the fact that not all children engage in each activity (Tobin, 1958), but they permit keeping time at the interval level. If OLS were used, the regression slope would be biased by the inclusion of zero values. The Tobit coefficients reflect both the effect of the independent variable on the probability of the activity and on the hours spent in the activity by participants (McDonald & Moffitt, 1980). The higher the proportion of children who participate in the activity, the more the results reflect the hours among participants and thus the more similar the results become to those from OLS regressions just on participants. Therefore, for activities in which all or almost all children participate (sleep, play, television), OLS was used.

Cluster Analysis of Activities of Children in the 1997 Wave—This analysis used the *kmeans* procedure in Stata to group children into four nonoverlapping groups by the amount of time spent playing video games; watching television; playing, communicating, or studying with the computer; playing sports; spending time out of doors; nonscreen studying; and reading for pleasure. This procedure assigns observations to the group with the most similar mean, new group means are determined, and the process continues until no observations change groups.

Child Achievement and Behavior in the Longitudinal Sample—We conducted two types of longitudinal analyses on a subsample of children who were 6–12 in 1997 and who were interviewed 5–6 years later. Because initial analyses showed significant interactions between media use and gender, all analyses are shown by gender. The first analysis is a lagged dependent variable analysis in which the achievement or behavior outcome of boys (or girls) in 2003 was regressed on media use in 1997, controlling for the same achievement or behavior measure in 1997 and a set of other control variables using OLS. These analyses control, in addition, for the mother's passage comprehension score because previous research has shown that children's scores are linked to maternal reading and vocabulary ability (Shonkoff & Phillips, 2000). The results can be interpreted as the change between 1997 and 2003 in the test score of a child who reported one more weekly hour of computer use, video game play, or television viewing in 1997 compared with a comparable child who reported one fewer hour. Interactions between Black race/ethnicity and computer play, computer communications, or video game time are included to test whether such media use differentially affects children of minority racial/ethnic groups. There were too few cases to interact Black with computer study or Hispanic with any of the media variables. Because the ratio of family income to needs was not related to behavior and was related only to the letter-word score of boys (in the unexpected direction), interactions between income and computer or video game use were not examined. An examination of the interaction between age group (6–8, 9–12) and media use showed a consistent interaction between age group and computer study because few 6–8 year olds used the computer for studying. This was not a substantively important finding and age interactions were not pursued further. The second model examines whether the effects of computer, video game, and television time are nonlinear, differing for moderate and high users, compared with low users or nonusers.

Our second analysis is a difference analysis. In this more rigorous test, the outcome is the change in achievement or behavior of the individual child across time associated with a change in media time. Differences in achievement and behavior problems scores were regressed on the difference in hours spent on the computer, playing video games, and watching television between 1997 and 2003 (2003 minus 1997). Because variables that do not change over time are not included, the only control variables included are age, number of children, household income, and family structure (in dummy categories). The results can be interpreted as the change in child achievement or behavior test score associated with spending an additional hour of time on the computer, video game, or television between 1997 and 2003, net of the controls. Results are presented separately for White boys, Black boys, White girls, and Black girls. Sample sizes were too small for separate analyses of Hispanic children. Effect sizes (d) were calculated by dividing the coefficient by the standard deviation of the dependent variable (Cohen, 1988).

Results

Univariate and Bivariate Findings

Sample Characteristics—Table 1 shows the weighted variable means and standard deviation of the continuous variable for the pooled cross-sectional sample of 2,562 children used to examine time spent in activities in 1997 and 2003. Of the children in this sample, 41% were 6 to 8 and 59% were 9–12. The sample was evenly split by gender. Three-quarters lived with two parents; 44% of the mothers had completed at least some college, and two-thirds were employed. Seventy-two percent were White, with 15% Black and 13% Hispanic. Most children lived in nonwarm states; only one-third of children lived in a warm state. Twenty-seven percent of the interviews were conducted in the fall, 41% in the spring, and 32% in the winter.

Bivariate Analyses of Children's Activities in 1997 and 2003—Columns 1 and 4 of the upper panel of Table 2 show the percentage of all children 6–12 who engaged in each of the media activities (watching television, using the computer, and playing video games) and other activities (nonscreen playing, sleeping, reading, nonscreen studying, playing sports, engaging in outdoor activities, and spending time in school) in the interview week in 1997 and 2003. Columns 1 and 4 of the lower panel show the average weekly hours spent in each activity each year, including those who spent no time in the activity. Comparable estimates for boys and girls by year are shown in columns 2–3 and 5–6. T-tests were conducted to examine change across time among all children (column 7), change across time by gender (columns 8–9), and gender differences within each year (columns 10–11).

Overall media activities: In 1997 and 2003 almost all children watched television (94.8% to 96.6%) (Table 2, upper panel). Between 1997 and 2003 the viewing time of 6–12 year olds increased from 13.09 hours to almost 14 (13.96) hours per week (Table 2, lower panel). The proportion of children 6 to 12 years old who used the computer in the study week increased from 18.2% to 29.2%. In 2003, children 6–12 averaged about 1.33 weekly hours on the computer, including those who did not spend any time on it.

Screen game play: Computers were primarily used for playing games, a use that increased over the period. The proportion of 6 to 12 year olds playing games on the computer rose from 14.1% in 1997 to 21.0% in 2003 and the average time (including zeroes) spent playing games increased from 0.58 to 0.81 hours per week. In 2003, younger children were as likely as older children to play games on a computer, 21.9% of 6–8-year-olds and 20.3% of 9–12-year-olds (not shown). The proportion of children 6–12 playing video games also increased between 1997 and 2003. In 2003, 36.1% of 6–12 year olds played video games, compared with 29.6% in 1997. In 2003, they spent about 2.29 hours a week doing so, compared with 1.52 hours in 1997. The proportion playing video games in 2003 was slightly higher for 9–12 year olds than for 6–8 year old children (39.3% vs. 31.7%, not shown). Gender differences in video game play, in contrast, were large. In 1997, boys were more than twice as likely to play video games (40.7%) as girls (18.5%). In 2003 the proportion of boys playing video games was 56.9% compared to 16.5% of girls and the only significant gender difference in media time was the time spent playing video games. Girls spent 0.82 hours and boys spent 3.86 hours playing video games in 2003.

Nonscreen play: Three-quarters of children (73.9%) engaged in nonscreen play. In 2003, the total weekly time 6–12 year olds spent in nonscreen play was 6.33 hours (Table 2, lower panel), representing a 20% decline from 7.85 hours in 1997. Because time spent in computer and video game play increased, total play time (sum of nonscreen, computer, and video game play) declined only slightly, from 9.95 to 9.43 hours (not shown in table). The fraction of total play time that was represented by computer and video-game play increased over the period relative to nonscreen time, from 21% to 33%.

Communications: Although still small, the use of the computer for communications, particularly the Internet and e-mail, more than doubled between 1997 and 2003, from 4.7% to 10.8%. The time spent in such activities rose from 0.14 hours in 1997 to 0.43 hours. In 2003, girls were more likely than were boys to use the computer for communications activities such as e-mail and surfing the Internet: 12.8% vs. 8.7%, respectively.

Studying and reading: The proportion of children who reported spending time studying increased significantly between 1997 and 2003. The increased studying documented here did not result from increased use of the computer for homework. Sixty-six percent of 6–12-year-old children reported nonscreen study time in 2003, compared with 58.2% in 1997, an increase

of 14%. The total weekly time spent in nonscreen study increased from 2.91 hours to 3.57 hours for all 6–12 year olds. The proportion studying with the computer (2% to 3% of children aged 6 to 12) and the amount of time spent studying on the computer (.09 to .10 hours) did not change over the period and both were low.

Increases occurred in reading over the period. In 2003, 47.2% of 6 to 12 year olds reported reading for fun during the survey week compared with 38.3% in 1997, an increase of 24% over the period. There was also a 31% increase in reading time for the entire age group — from 1.19 to 1.56. Thus, there has been a real increase in reading, though, overall, the proportion and the amount of time spent reading for pleasure were low.

Physical activities and sleep: Sports include formal team sports and informal sports activities for recreation. Outdoor activities include activities such as walking, pleasure drives, horseback riding, gardening, and camping. Participation in sports was lower in 2003 (60.4%) than in 1997 (76.2%). The amount of time spent playing sports was also lower by almost 2 hours in 2003 (3.95) compared to 1997 (5.84). Participation in outdoors activities declined by more than 50% from 1997 (16.2%) to 2003 (10%), and the amount of time spent in such activities also declined over the period, from 0.63 to 0.44 hours. All children sleep, but they may sleep for different amounts of time. The results indicate that time spent sleeping increased slightly from 1997 to 2003 for 6–12 year olds from 69.03 to 70.74 hours per week.

Tradeoff between Media and other Activities

The descriptive results show gross change in activities over time; however, they do not adjust forpotential differences in family socioecono mic circumstances and seasonality across the two years. The bottom panel of Table 3 shows the tradeoffs between children's video game time, television viewing time, and computer time (in the rows) and the key dependent variables of time in nonscreen play, sleep, reading, nonscreen study, sports, and outdoor activities in columns across the top, adjusting for SES and other differences (shown in top panel). The table also includes television viewing, video game play, computer play, computer study, and computer communications across the top to test cross-media tradeoffs. Hours spent in school are controlled to adjust for the hours they have available. Results for boys and girls were similar and are not presented separately. (Table 3 about here)

Is greater media use associated with less time in unstructured activities such as nonscreen play and sleep?—More time on the computer (playing, studying, or communicating), playing video games, or watching television were all associated with reduced time spent in nonscreen play. The results also showed that greater amounts of time spent playing computer games, using the computer for communicating, and watching television were associated with less sleep. Neither computer studying nor video game playing was associated with reduced sleep.

Is reading for pleasure displaced by media?—The more time spent playing video games and watching television, the less time spent reading for pleasure. However, spending more time in computer play, studying, or communicating was not associated with reduced time reading. In fact, the more hours spent using the computer for studying, the *greater* the time spent reading.

Is studying is being displaced by media?—As with reading, the results showed that greater video game and television time were associated with less nonscreen study time. The amounts of time spent studying with or communicating using the computer were not associated with time spent in nonscreen studying. However, more time spent playing computer games was associated with less nonscreen study time.

Does media time interfere with *playing sports or spending time outdoors*?—The associations between television viewing hours and sports time and between computer play and sports time were negative. Video game time, computer study hours, and computer communications were not related to time playing sports. Greater video game time was associated with less time spent in *outdoor activities*, but computer time was not.

Are there *tradeoffs among the different forms of media?*—Video game play and television time do not appear to be incompatible. Children who spent more time playing video games did not appear to spend less time watching television; however, there was a negative association between computer studying and television viewing. Finally, video game time was negatively associated with computer game play and computer communication hours.

Cluster Analysis of Children's Activities—This research has, so far, focused on separate media time variables, failing to consider the fact, shown in Table 3, that children's activities are interrelated. The results of a cluster analysis based upon their media and other activities are shown in Table 4 for boys and for girls. The first column in the top panel shows the mean time across all boys; the second through fourth columns show means for boys grouped into *jocks*, *couch potatoes*, *studiers*, and *gamers*. Jocks averaged almost 20 hours of sports per week, couch potatoes almost 24 hours watching television, and gamers almost 14 hours playing video games. Studiers spent 4 hours studying without the computer, about 10 minutes studying with the computer, about 1.3 hours reading, and 1 hour in computer play. Although not high compared with the main activities of jocks, couch potatoes, and gamers, these times exceeded the average. Among boys, 21% were categorized as jocks, 27% couch potatoes, 44% studiers, and 8% gamers.

Among girls, the categories were similar except that the fourth group was more heterogeneous than for boys. Because few girls were heavy gamers, we refer to it as "other." Compared with boys, female jocks averaged slightly fewer sports hours (16 hours), but couch potatoes averaged more television viewing time (30 hours). Female couch potatoes also spent time playing video games (1 hour) and computer games (1/2 hour). Studiers spent a bit less time studying than comparable boys (3.6 hours), still more than average. Females in the "other" category spent an average amount of time watching television (15.4 hours) and a bit more time than average playing both video games (.83 hours) and computer games (.59 hours). Among girls, 13% were categorized as jocks, 15% couch potatoes, 37% studiers, and 35% other.

Media and Achievement, Lagged Analysis

Table 5 provides the means and standard deviations for the longitudinal file of children 6–12 in 1997 who were reinterviewed in 2003. Black children lived with mothers with less education and a lowest vocabulary score, their family was more likely to be headed by a single mother, and their family incomes were lower than those of White children. Black children had lower achievement test scores than did White children but a similar level of behavior problems. Finally, Black boys and girls were less likely to use the computer at home during the study week but were more likely to watch a lot of television than were White boys and girls.

Effects of Background Factors on Achievement in 2003—Table 3 showed that, compared with those whose mother had not attended any college, children whose mothers had completed college played fewer video games, watched less television, and spent more time reading. Similarly, those living in families with a higher ratio of income to needs watched less television and played more on the computer. These SES-activity links would likely produce a positive association between computer use and achievement and a negative association between video game use and achievement if SES were not controlled.

Main Effects of Study Time on Achievement in 2003—Original analyses showed significant zero-order associations between computer and video game time and children's test scores, However, when background factors and the child's and mother's 1997 score on that same test were controlled there were no associations between computer game play hours, computer communications, video game hours, or television viewing hours in 1997 and achievement in 2003 for boys or girls. Two associations were significant. For girls (Table 6, model 1), greater computer study hours were associated with a significantly lower score on the applied problems test, opposite that expected ($b = -2.31$, $p < .05$). The effect size (d) was − .14 ($p < .05$) for girls' and − .02 (*ns*) for boys' computer study. Pooling over boys and girls (not shown), the interaction between gender and time spent studying on the computer was significant. Girls who spent more time studying had a significantly lower applied problems test score than boys who spent more time studying. There was also a significant negative association between studying and boys' scores on the passage comprehension test ($b = -.71$, $p < .05$). However, this did not differ by gender. The coefficient for girls was about the same size as for boys but was not significant.

Main Effects and Interactions between Race and Time spent in Computer Communication—Although the main effects of computer communications and play were not significant, there were substantial main effects of race/ethnicity, with minorities achieving lower scores on all the achievement measures. Black boys scored 7.77 points lower than White boys and Black girls scored 3.57 points lower than those of White girls on the passage comprehension test. Interactions between Black race and computer use and Black race and video game use were included in Model 1 (Table 6). The main effects of computer study hours did not change and computer communication and computer play hours were still not significantly associated with the child's passage comprehension score, but the interaction between Black and computer communication hours was significant for several achievement tests. Black boys and girls who spent more time in 1997 in communications activities, such as surfing the net and e-mail, had passage comprehension scores in 2003 higher by 8.98 and 8.33 points, respectively, than Whites who were similarly active. After adding together the main and interaction effects of Black race and communication to obtain total effects, Black boys' passage comprehension scores were 1.03 points above those of White boys ($d = .06$), and Black girls' passage comprehension scores exceeded those of comparable White girls by 5.92 ($d = .40$), if they used the computer for communication. Black girls also had higher scores than White girls on the letter-word test if they were more active users of computers for communication; the sum of the main and interaction effects was 1.12 ($d = .05$).

Amount of Use—Discrete categorical effects may not be captured by these continuous measures. Less than one-fifth of elementary school-age children used the computer at home during the week in 1997 but the top quartile spent 6 or more hours on the computer. The analysis of media use grouped by low to moderate and high versus no hours (or medium and high versus low television hours) is shown in Table 6, Model 2. *Low to moderate computer hours* were positively and significantly associated with higher passage comprehension scores ($b = 4.12$, $p < .05$, $d = .27$) and to marginally higher applied problems scores ($b = 3.21$, $p < .10$, $d = .18$), but only for girls. *High video game hours* were, for girls, associated with a significantly lower score ($b = -11.04$, $p < .05$, $d = .73$) on the letter-word test and a marginally lower score ($b = -7.75$. $p < .10$, $d = .48$) on the applied problems test. There were, surprisingly, no associations between the measures of boys' overall computer and video game time in 1997 and their achievements in 2003.

Media and Behavior Problem, Lagged Analysis

Main effects of Media and Media-Gender Interactions on Behavior Problems—We report results only for total behavior problems; similar results were obtained for internal

and external problems. No direct associations between media use and behavior problems were found for boys (Table 6, Model 1). For girls, greater computer play hours were associated with marginally reduced behavior problems ($b = -.50$, $p < .10$, $d = .05$)(Table 6, model 1). There was a significant interaction between gender and computer play. Girls who spent more time playing computer games had a lower behavior problems score than boys (not shown).

Interaction between Media Time and Race—Media time and race did not interact in their association with behavior problems.

Amount of Media Use—Finally, in Model 2 of Table 6, which categorized media by level of use, spending a greater amount of time on the computer was associated with lower behavior problems for girls ($b = -8.86$, $p < .001$) but not boys, and the effect size was large ($d = .95$). Video game hours were not significantly linked to behavior problems for girls and none of these categories was linked to boys' behavior problems. Moderate television viewing was associated with greater behavior problems for girls ($b = 7.98$, $p < .05$) but not boys.

Changes in Children's Test Scores, 1993–2003

Table 7 shows the results of regressing the difference between children's 1997 and 2003 achievement test and behavior problems scores on the difference between children's 1997 and 2003 media time. A positive association means that an increase in media time was associated with an increased score on that particular test. Because the previous analyses suggested differences both by gender and race, the tables shows the results separately for White and Black boys and White and Black girls. The same background controls—age of child, number of children, household income, and number of parents—were included in each analysis, but are not shown in the bottom panel of the table. Effect sizes are shown in Table 8.

Boys' Achievement—Among boys, the relationship between computer use and achievement varied by race/ethnicity. For White boys, increased *computer communications* was associated with a significantly lowered score on both the passage comprehension ($b = -.27$, $p < .05$) and applied problems tests ($b = -.28$, $p < .05$). For Black boys, in contrast, increased *computer communications* was associated with increased passage comprehension (b= .95, p<. 05). For Black boys, in addition, increased *computer study time* was associated with an *increased* score on the passage comprehension test ($b = 3.71$, $p < .01$). Change in video game time was not associated with change in boys' achievement for any group. Finally, increased television viewing hours were associated with an increased score on the letter-word test for White boys.

Girls' Achievement—Computer time was consistently positively associated with White girls' achievement. Greater time spent *playing games on the computer* was associated with increased passage comprehension ($b = .99$, $p < .05$) and applied problems test scores ($b = .98$, $p < .05$) between 1997 and 2003 for White girls.

In contrast to the positive association between computer game play and achievement, *playing video games* was detrimental to the achievement of White girls. For them, increased video game time was associated with a significantly reduced score on the letter-word test between 1997 and 2003 ($b = -.69$, $p < .05$). For Black girls, increased video game hours were associated with a reduced score on the passage comprehension test ($b = -1.22$, $p < .05$) but with an increased score on the applied problems test ($b = .54$, $p < .05$). Increased television viewing was also associated with a reduced passage comprehension score for Black girls.

Boys' Behavior Problems—For boys there was no association between computer hours and behavior problems. In contrast, increased time spent playing video games between 1997

and 2003 was associated with increased externalizing behavior problems (b = .01, p <.05). Although the positive relationship was found for both Black and White boys, the effect sizes were small, .01–.02.

Girls' Behavior Problems—For White girls, playing more on the computer between 1997 and 2003 was associated with reduced internalizing problems whereas increased time spent studying was associated with increased internalizing behavior problems. Watching more television was associated with fewer externalizing problems for Black girls. Finally, in contrast to boys, Black and White girls who played more video games between 1997 and 2003 did not experience increased internalizing or externalizing behavior problems.

Discussion

The research reported here described the use of media at home by U.S. 6–12 year olds and linked it to their achievement and behavior in adolescence in 2003.

Change over Time

Television remains the dominant medium in middle childhood. In 2003, children spent 14 hours per week watching television, an increase from 13 hours in 1997. The use of computers and video games at home also increased between 1997 and 2003, but the proportion using them and the time spent were still relatively low. Almost three out of ten children 6 to 12 used the computer at home in an average week in 2003 and the average time spent was about 1 hour and 20 minutes over all children. Three-fifths of children's computer time was spent playing games, one-third was spent in communications, and the remainder was spent studying. Between 1997 and 2003 increases occurred both in computer game playing and in computer communications, primarily e-mail and Internet use. The small amount spent studying did not change. Although total computer time in 2003 was similar for boys and girls, girls were more likely to use the computer for communications and boys were more likely to use it to play games. Video game play was highly gender differentiated. In 2003, 57 percent of boys and only 17 percent of girls played a video game during the week of the interview. Including everyone, boys played for almost 4 hours compared with less than one hour for girls. This equals 6.8 hours for boys who played and 4.8 for girls who played. Because nonscreen play time declined for all children and computer and video game play increased, screen play occupied a larger fraction of children's total play time in 2003 than in 1997, 33% versus 21%.

Media Displacement of Other Activities

Some displacement was expected. As hypothesized, tradeoffs across activities that are functionally equivalent, less structured, and less beneficial at the margin were supported. One example of the displacement of functionally similar activities was that greater video game play time was associated with less computer play time. There was no association between computer and noncomputer study time, indicating that computer studying is not equivalent to and does not displace nonscreen studying. Greater time in any media activity was associated with less time spent in nonscreen play, supporting the hypothesis of substitution of structured for less structured time. Greater use of all media except video games was associated with less sleep, supporting the marginal benefits hypothesis. Although television time was also expected to decline, greater computer studying was the only activity associated with less television viewing. The results are consistent with expansion in programming and inconsistent with a negative effect on old media of new media. Television has a unique niche — one that is not easily displaced.

Of new media, only video game play was associated with spending less time in three achievement- or health-related activities — reading, studying, and spending time out of doors.

Computer play was also associated with less time spent in sports whereas video game play was not. The availability of sports games may make video gaming attractive to both sports participants and nonparticipants. Playing computer games was similar to playing video games in that each had a negative association with nonscreen studying. Rather than implying causality, these results showed that children's activities clustered into stereotypical categories of *jocks*, *couch potatoes*, *studiers*, and *gamers*, according to how they spent their extracurricular time.

Media Use and Achievement

Computer use—Consistent with observational learning theory, greater *computer use* overall, particularly low to moderate computer use, appeared to be consistently and positively linked to reading and problem-solving achievement in adolescence five years later for girls but not boys. Use and motivation theory was important to the interpretation of the findings because the association depended on whether the computer was used for playing games, for studying, or for computer communications such as e-mail and Internet use. As suggested by use and motivation theory, associations varied by race/ethnicity as well as gender. For White girls, increased time spent playing games on the computer between 1997 and 2003 was associated with an increased score on the passage comprehension and applied problems tests in the change analyses. In the lagged regressions, Black girls who spent more time in computer communications had scores on the passage comprehension and letter word tests high enough to outweigh their overall lower score compared with White girls. The overall positive effect of computer use for girls reflected the fact that the majority of computer time was spent playing games. This study, unfortunately, had no information on the types of games children were playing on the computer. However, girls of this age are likely to be playing educational games, in contrast to older children who may be playing games of strategy and adventure (Wright et al., 2001b). Research indicates that girls are much less facile and comfortable with computers than boys (Vered, 1998); greater experience with them is likely to give girls an achievement edge.

For White boys the results were surprising. There were no positive associations of computer use with achievement in the lagged or difference models for White boys and there was one negative association: an increase in time spent in computer communications between 1997 and 2003 was associated with a decline in passage comprehension and applied problems scores. Boys may become too involved in the e-mail and Internet functions of computers to focus on their homework assignments. Computers are not a magic bullet to improve children's academic success. Other research suggests that the use of computers for academic work is underdeveloped (Rathbun, West & Hausken, 2003).

For Black boys, in contrast, the news was somewhat better. As for Black girls, in both the lagged variable and difference analyses Black boys who spent more time in computer communications and studying between 1997 and 2003 had increased passage comprehension test scores. The results suggest that greater computer use is associated with higher achievement of White girls, Black girls, and Black boys.

Although a significant negative association between computer study and later achievement was found in the lagged dependent variable regressions for both boys and girls, this finding reversed direction in the difference analyses. The difference models found that increased computer studying was associated with an increased score on the applied problems test for White girls and on the passage comprehension test for Black boys. Study behavior is selective; students who are having problems in school may be encouraged to spend more time studying. The difference analysis examined changes in the achievement of the individual student associated with changes in media use across time, eliminating this selectivity.

Video game play—In contrast to what was expected based upon observational learning theory, video game playing had neither positive nor negative associations with any measures of boy's academic achievement. However, it had both positive and negative associations with girls' achievement. Even though fewer girls than boys played games overall, increased video game hours between 1997 and 2003 were associated with a lower letter-word test score for White girls and a lower passage comprehension score for Black girls. At the same time, increased video game hours were associated with an increased score on the applied problems test for Black girls. Video games do not generally improve practice in vocabulary or reading skills; however, they do teach problem-solving skills; the applied problems test is the one test on which Black girls improved their scores with increased video game play. The results support the argument that video game play has the potential to improve learning. However, excessive video game time appears detrimental to learning; a high level of video game play was linked to a reduced applied problems test score for girls in the lagged models. The reason for detrimental effects on learning is that video game time displaces valuable reading and study time. If reading and study time were not displaced, video games could improve learning. Lowered reading and studying time may be more detrimental to girls' reading achievement than that of boys. More research needs to consider the types and circumstances in which girls play video games and to examine differences between the game play of Whites and Blacks.

Media Use and Behavior Problems

Cultivation theory focused upon the types of messages children receive from media. According to cultivation theory, greater computer and video game use should be associated with more externalizing behavior problems because of aggressive content and with more internalizing behavior problems because these are individual activities. Media may also be linked to behavior problems because of displacement of normal outdoor activities.

Computer use—Consistent across both longitudinal analyses, increased computer game playing was associated with *reduced* internalizing behavior problems for girls, possibly because of social networking. However, consistent with the previous discussion about greater studying linked to school problems, the difference analysis found increased studying linked to *increased* internalizing problems for Black girls. Studying may have social costs in terms of isolation. Computer use did not influence boys' internalizing or externalizing behavior problems.

Video game play—Although computer time did not displace outdoor activities, video game play did. The hypothesis from cultivation theory predicting that greater video game use would be associated with behavior problems was supported for externalizing behavior for boys. In the difference analysis, increased video game hours between 1997 and 2003 were associated with increased externalizing behavior problems for all boys but not for girls. Boys who spend time playing video games spend less time in active outdoor pursuits, which may be a source of these behavior problems. This finding supports other research that has found video game play to be associated with aggressive behavior; however, the effect sizes are quite small in this national sample of children. The results did not support the hypothesis that increased game play would lead to social isolation.

Variation in Media Influence by Race

Use and motivation theory led us to expect that there would be substantial variation in the association between media and children's achievement and behavior depending upon current use levels, motivation, and disposition of the user. Perhaps because of their lower initial level of computer use, the potential of home computer use for achievement was greater for Black boys and Black girls than White boys. Greater time spent with the computer for study and communications was associated with higher achievement for Black boys and Black girls

compared to White boys. The boost resulting from computer communications alone was sufficient to offset the substantial Black-White test score gap. Black boys and White boys have a similar risk of increased aggressive behavior problems, but the risk is small. For African American children, the computer provides an opportunity for higher achievement with a minimal risk of internalizing or externalizing behavior problems.

Strengths and Limitations

There were several limitations of the present study. It examined only primary and not secondary media use. Cell phone and music media use, which are likely to fall in the multitasking category, have become widespread, requiring a method for examining how children spend their time that includes multiple uses of time. However, supplementary analyses indicated that incorporating multitasking would not have changed the findings. In addition, this study focused only on computer use at home and did not incorporate computer use in the school setting. Finally, although computer use was divided by type of use, television viewing content was not examined. This limits the conclusions that can be drawn about the association of television viewing with achievement. Consistent with this limitation, few associations between television viewing time and children's achievement and behavior were found and the effects were small. The content of video games was also not considered; the potential association between violent video game time and behavior problems could not be examined.

This study has offsetting strengths. For the first time, this study provides a nationally representative picture of the primary media activities of children 6–12 in 1997 and 2003 in the United States, a description of the changes in media use that occurred in a period of rapid social change, and estimates of the association of changes in media use with changes in children's achievement from interviewer-administered standardized tests and behavior reported by parents.

Implications

This research shows that whereas television and video games may crowd out positive activities, computer use does not. Home computer use among girls in middle childhood has potential benefits for their achievement in adolescence. The achievement of Black children is associated with greater computer use more than that of White children and there are relatively few risks to behavior for Black children. This research suggests that the vocabulary and reading test score gap between Black and White boys and girls may be at least partially offset through children's higher use of computers at home. Computer literacy is essential for full participation in the information society, and increased access to computers would reduce the disadvantage across generation. Although access and use at school could reduce this divide, most research suggests that, even today, only a fraction of children use computers regularly at school. At present, home computer use is limited among children from minority families; efforts to expand the presence of computers in low income homes could improve their children's academic performance. The results showing greater potential benefits to Black children also suggest an area in which outreach could help narrow the achievement gap between Black and White children. Benefits also are likely to accrue to Hispanic children; the sample was too small for reliable estimates.

Finally, the conclusions regarding the positive associations of computer game play with achievement do not apply to video game play. Even though boys spend more time playing video games than girls, their achievement does not appear to be significantly affected, at least at the levels of play occurring in 1997 and 2003. Although girls' vocabulary and reading declined with greater video game use, increased video game play was associated with increased problem solving skills for girls. As expected, moderate use appeared to be beneficial whereas extensive video game time was not. Boys' *behavior* is at risk as a result of video game use; the

results showed a consistent detrimental association of video game time with the externalizing behavior of boys, though the effect was small. Greater video game time has been shown in other studies to lead to more aggressive behavior. This is an important caveat for those who write about the potential benefits of electronic game playing. More research is needed to include school use, to incorporate other media and multitasking, and to examine the longer-term correlates of media involvement into young adulthood.

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Table 1

Means of Variables Included in Cross-Sectional Analysis

Variable	Mean	SD
White and other	0.72	-
Black	0.15	-
Hispanic	0.13	-
Male	0.49	-
Age is 6–8	0.41	-
Mother completed high school or less	0.56	-
Mother completed some college	0.22	-
Mother completed college or more	0.22	-
Mother is employed	0.67	-
Two parents (vs. one parent)	0.77	-
Three or more children	0.42	-
Family income to poverty ratio	3.40	3.83
Lives in warm state	0.31	-
Interview conducted in fall	0.27	-
Interview conducted in winter	0.32	-
Interview conducted in spring	0.41	-
Year is 1997	0.52	-
N	2,562	

Note: All data are weighted. Hispanic children are included in totals.

Table 2

Percentage of Children 6–12 Participating in Selected Activities and Weekly Time, 1997 and 2003, by Gender

	1997			2003			1997 vs. 2003			1997	2003
Activities	**All**	**Boys**	**Girls**	**All**	**Boys**	**Girls**	**All**	**Boys**	**Girls**	**boys vs. girls**	**boys vs girls**
N	1323	671	652	1239	637	602					
Percent Participating											
Television, total	94.8%	95.5%	94.2%	96.6%	97.5%	95.8%	*				
Computer, total	18.2%	18.0%	18.4%	29.2%	28.6%	29.8%	***				
Computer play	14.1%	14.6%	13.7%	21.0%	22.4%	19.6%	***				
Computer study	2.0%	1.5%	2.5%	2.6%	2.2%	3.0%					
Computer communications	4.7%	4.9%	4.5%	10.8%	8.7%	12.8%	***		*		*
Video games	29.6%	40.7%	18.5%	36.1%	56.9%	16.5%	**	***	***	***	***
Nonscreen play	83.4%	81.9%	84.9%	73.9%	76.0%	71.8%	***				
Sleeping	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%					
Reading	38.3%	35.3%	41.5%	47.2%	45.1%	49.1%	***	*		*	
Nonscreen study	58.2%	61.5%	54.9%	65.6%	65.9%	65.3%	***	*		*	
Sports	76.2%	79.2%	73.1%	60.4%	63.4%	57.5%	***	**	*	**	*
Outdoors	16.2%	16.9%	15.6%	10.0%	7.9%	12.0%	***		*		*
School	90.8%	91.6%	89.9%	90.6%	90.9%	90.2%	***				
Weekly Hours of Everyone in Activities (Users and Nonusers)											
Television, total	13.09	13.19	12.99	13.96	14.14	13.80	*				
Computer, total	0.82	1.02	0.61	1.33	1.37	1.29	***	**		**	
Computer play	0.58	0.73	0.42	0.81	0.92	0.72	**	**		**	
Computer study	0.10	0.10	0.10	0.09	0.06	0.11					
Computer communications	0.14	0.20	0.09	0.43	0.39	0.46	***	*		*	
Video games	1.52	2.29	0.75	2.29	3.86	0.82	***	***	***	***	***
Nonscreen play	7.85	7.47	8.24	6.33	6.38	6.27	***				
Sleeping	69.03	68.86	69.20	70.74	70.51	70.96	***				
Reading	1.19	1.09	1.28	1.56	1.43	1.68	***				
Nonscreen study	2.91	3.15	2.66	3.57	3.57	3.56	***	*		*	
Sports	5.84	7.07	4.60	3.95	4.67	3.28	***	***	***	***	***

	1997			2003			1997 vs. 2003			1997	2003
Activities	**All**	**Boys**	**Girls**	**All**	**Boys**	**Girls**	**All**	**Boys**	**Girls**	**boys vs. girls**	**boys vs girls**
Outdoors	0.63	0.55	0.72	0.44	0.28	0.59	***		**		**
School	32.89	33.39	32.38	33.07	33.08	33.07					

*** p<.001,

** p<.01,

* p<.05,

t-tests across years for all and by gender, then by gender within year

Note: All data are weighted

Table 3

Regression Coefficients for Tradeoff between Weekly Hours in Selected Activities

Variable	Nonscreen Play OLS	Sleeping OLS	Reading Tobit	Nonscreen Study Tobit	Sports Tobit	Outdoors Tobit	Television OLS	Video games Tobit	Computer play Tobit	Computer study Tobit	Computer communications Tobit
Background:											
Black	−2.06 **	0.53	−1.29 **	1.37 **	−2.22 **	−3.91 **	2.01 **	0.66	−0.98	−3.53	−5.41 ***
Hispanic	−1.78 **	−0.05	−1.50 *	1.89 **	−2.29 *	−1.11	1.02	−1.94	−2.50 *	−1.57	−0.65
Male	0.32	0.00	−0.11	0.72 *	2.75 ***	0.09	0.39	7.24 ***	1.25 *	−2.14	−0.02
Age is 6 to 8	3.31 ***	2.56 ***	0.00	−2.44 ***	−2.33 ***	0.14	−1.79 **	−1.83 **	−1.28 *	−4.82 **	−4.23 ***
Mother completed some college	−0.10	−1.17 *	−0.02	0.37	0.14	0.89	−3.16 ***	−0.27	1.38	−0.49	1.93
Mother completed college or more	−0.86	−1.18 *	0.99 *	0.82	1.28 *	0.94	−3.47 ***	−2.29 **	1.26	2.21	0.72
Mother is employed	−1.66 ***	−0.24	−0.62 *	0.21	0.81	−0.51	−0.26	0.26	−0.48	−0.71	0.44
Two parents (vs. one parent)	0.24	0.66	0.48	−0.40	−1.47 *	0.83	−0.49	−0.48	0.35	−0.75	−0.40
Three or more children	0.41	0.52	0.14	−0.46	−0.01	−0.55	−0.41	−0.58	0.21	−1.11	−0.09
Family income to poverty ratio	0.03	−0.11	0.05	0.05	0.05	−0.10	−0.18 **	0.04	0.09 *	0.04	0.09
Lives in warm state	0.30	−0.61	−0.34	0.15	1.42 *	0.40	−0.26	−1.33 *	−1.58 *	1.83	−1.96 *
Interview conducted in fall	0.40	−0.68	−0.10	−0.20	0.05	0.14	−1.62 *	−1.30	−0.71	1.14	−0.40
Interview conducted in spring	0.86	−1.88 *	−0.24	−1.86 **	2.54 *	1.59	−0.68	0.18	−0.49	−1.13	−0.68
Year is 1997	1.06	−0.85	−0.85 *	−0.18	0.95	1.36	−0.45	−2.35 *	−1.61	0.37	−3.64
Weekly hours:											
Computer play	−0.19 **	−0.18 *	−0.04	−0.22 *	−0.26 *	−0.23	−0.18	−0.11	--	0.36	0.44 ***
Computer study	−0.49 ***	−0.41	0.26 *	−0.05	−0.21	0.14	−0.56 **	−0.14	0.64 *	--	0.69 *
Computer communications	−0.21 **	−0.30 **	−0.10	0.15	−0.20	−0.05	0.02	−0.46 *	0.20	0.57 *	--
Video games	−0.20 ***	−0.08	−0.16 ***	−0.12 **	0.00	−0.42 *	−0.06	--	−0.16 *	−0.04	−0.28 *
Television	−0.11 ***	−0.18 ***	−0.10 ***	−0.11 ***	−0.16 ***	−0.08	--	−0.03	−0.06	−0.28 ***	−0.01
School	−0.16 ***	−0.25 ***	−0.06 ***	0.08 ***	−0.10 ***	−0.05	−0.22 ***	−0.05	−0.07 **	−0.03	−0.01
Constant	13.29 ***	81.74 ***	3.26 ***	1.69 †	7.07 ***	−8.70 ***	24.95 ***	−1.82	−2.61 †	−12.78 **	−7.13 **

*** p<.001,

** $p<.01$,

* $p<.05$,

† $p<.10$

Note: N=2,562. Data are weighted. Robust standard errors computed using Stata.

Table 4

Weekly Hours in Activity, By Cluster

	BOYS Couch				
Activity	**Total**	**Jocks**	**Potatoes**	**Studiers**	**Gamers**
Video games	2.33	2.15	1.58	1.47	13.91
Television	12.88	10.90	23.78	7.69	10.96
Computer play	0.74	0.67	0.41	0.98	0.51
Computer study	0.11	0.09	0.11	0.14	0.00
Computer communications	0.14	0.14	0.28	0.06	0.15
Sports	7.12	19.74	4.36	4.22	4.35
Outdoors	0.46	0.48	0.44	0.51	0.24
Noncomputer study	3.01	2.01	2.15	4.02	2.33
Reading	1.12	0.90	1.07	1.33	0.36
N	616	134	166	268	48

	GIRLS Couch				
Activity	**Total**	**Jocks**	**Potatoes**	**Studiers**	**Other**
Video games	0.71	0.43	0.90	0.63	0.83
Television	13.01	12.08	29.80	5.04	15.41
Computer play	0.44	0.32	0.57	0.31	0.59
Computer study	0.10	0.00	0.00	0.13	0.15
Computer communications	0.07	0.07	0.00	0.11	0.05
Sports	4.61	15.52	2.29	3.82	1.86
Outdoors	0.68	0.61	0.20	1.15	0.40
Noncomputer study	2.59	2.18	1.34	3.62	2.13
Reading	1.26	0.76	1.00	1.58	1.21
N	608	82	90	223	213

Table 5

Means of All and Standard Deviations of Continuous Variables in Longitudinal Analyses

	Girls						T-test White vs Black	Boys						T-test White vs. Black
	Total		White		Black			Total		White		Black		
Variable	Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD	
Background:														
White and other	0.73	---	---	---	---	---		0.72	---	---	---	---	---	
Black	0.13	---	---	---	---	---		0.18	---	---	---	---	---	
Hispanic	0.14	---	---	---	---	---		0.10	---	---	---	---	---	
Age of Child	9.56	2.05	9.64	1.99	8.94	2.18	**	9.32	1.99	9.33	1.95	9.54	2.09	
Mother completed high school or less	0.53	---	0.41	---	0.71	---	***	0.49	---	0.41	---	0.59	---	**
Mother completed some college	0.25	---	0.31	---	0.19	---	*	0.28	---	0.30	---	0.32	---	
Mother completed college or more	0.22	---	0.28	---	0.10	---	***	0.23	---	0.29	---	0.08	---	***
Mother's passage comprehension score	31.73	---	33.19	4.46	27.39	5.34	***	32.50	4.79	33.87	3.73	28.49	4.50	***
Two parents (vs. one parent)	0.81	---	0.87	---	0.37	---	***	0.77	---	0.85	---	0.38	---	***
Three or more children	0.46	---	0.39	---	0.51	---		0.45	---	0.39	---	0.50	---	*
Family income to poverty ratio	3.31	---	4.02	4.99	1.42	1.49	***	3.28	3.07	3.81	3.15	1.80	1.76	***
Dummy variables for Media Use:														
Computer hours - low to moderate	0.17	---	0.20	0.40	0.06	0.24	**	0.12	0.32	0.15	0.36	0.04	0.20	**
Computer hours - high	0.03	---	0.03	0.18	0.01	0.12		0.07	0.25	0.08	0.27	0.04	0.19	
Video game hours - low to moderate	0.15	---	0.16	0.37	0.11	0.31		0.32	0.47	0.33	0.47	0.31	0.46	
Video game hours - high	0.02	---	0.02	0.13	0.07	0.26	***	0.10	0.30	0.10	0.30	0.13	0.34	
TV hours - moderate	0.02	---	0.03	0.17	0.01	0.08		0.04	0.20	0.05	0.22	0.02	0.15	
TV hours - high	0.24	---	0.19	0.40	0.40	0.49	***	0.22	0.42	0.20	0.40	0.37	0.48	***
Achievement and Behavior														
Passage comprehension 1997	108.59	16.53	110.53	15.98	99.75	16.09	***	105.71	15.88	108.09	15.41	96.83	13.19	***
Passage comprehension 2003	103.75	15.11	107.15	14.22	94.95	12.81	***	101.65	17.31	106.09	16.84	91.40	14.06	***
Applied problems 1997	109.13	16.60	111.59	15.71	98.44	17.48	***	112.86	18.47	116.50	17.72	100.22	12.78	***
Applied problems 2003	102.58	17.12	106.92	15.70	90.75	13.62	***	105.83	16.56	110.55	15.85	93.44	11.74	***
Letter word 1997	109.87	19.14	112.18	18.72	99.31	15.09	***	105.96	19.27	108.64	18.47	95.68	18.41	***
Letter word 2003	107.47	20.45	111.11	20.21	93.68	16.66	***	103.11	20.37	108.37	19.87	89.10	16.24	***

	Girls						T-test White vs Black	Boys						T-test White vs. Black
	Total		White		Black			Total		White		Black		
Variable	Mean	SD	Mean	SD	Mean	SD		Mean	SD	Mean	SD	Mean	SD	
Total behavior problems 1997	39.64	8.45	39.93	8.81	38.04	8.07		40.77	8.22	40.37	7.92	41.48	8.83	
Total behavior problems 2003	41.04	9.26	40.91	9.3	39.55	8.1		40.91	9.31	40.54	8.89	41.37	10.62	
External behavior problems 1997	0.13	1.02	0.17	1.07	−0.19	0.80		0.10	1.03	0.17	1.09	−0.01	0.95	
External behavior problems 2003	0.08	1.00	0.04	0.99	−0.19	0.79		0.01	1.00	−0.02	0.76	0.07	1.08	
Internalizing behavior problems 1997	−0.24	0.88	−0.23	0.90	−0.27	0.86		0.02	1.02	−0.04	1.02	0.26	1.04	
Internalizing behavior problems 2003	−0.12	0.92	−0.14	0.92	−0.09	0.85		0.08	1.06	0.04	1.04	0.28	1.22	
N	538		297		201			536		288		218		

Note: All data are weighted. Hispanic children are included in totals.

*** p<.001,

** p<.01,

* p<.05

Table 6

Regression Coefficients for Child Scores in 2003 by Weekly Media Use in 1997, by Gender[a]

	Letter word		Passage Comprehension		Applied Problems		Behavior Problems	
Variable	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Boys								
Computer play	0.36		0.50		0.33		0.02	
Computer study	−0.45		−0.71 **		0.39		0.08	
Computer communications	−0.65		−0.18		−0.43		−0.42	
Video games	−0.05		0.02		0.01		−0.02	
Television hours	−0.15		0.08		0.07		0.01	
Child is black	−10.55 **	−9.34 **	−7.77 *	−6.32 *	−6.11 **	−5.36 **	−0.79	−0.73
Child is black* computer play	−1.02		−0.23		−0.77		0.67	
Child is black* computer communications	2.37		8.98 *		3.50		1.63	
Child is black* video game	0.21		0.42		0.17		−0.18	
Computer hours - low to moderate		0.68		2.13		3.65		−1.25
Computer hours - high		−1.50		7.93		−2.19		−2.63
Video game hours - low to moderate		0.36		0.21		−1.21		0.60
Video game hours - high		0.84		1.44		2.07		0.13
TV hours - moderate		2.79		−4.33		7.40		5.28
TV hours - high		−2.23		1.67		1.23		0.98
R^2	0.58	0.57	0.46	0.45	0.53	0.53	0.33	0.32
N	439	439	428	428	439	439	536	536
Girls								
Computer play	1.21		0.31		0.31		−0.50 †	
Computer study	−1.23		−0.68		−2.31 **		−0.26	
Computer communications	−1.20		0.66		0.23		0.01	
Video games	−0.52		0.14		−0.11		0.33	
Television hours	0.01		0.08		−0.02		0.05	
Child is black	−3.67	−3.36	−3.57 *	−3.20 *	−5.81 **	−5.61 **	−0.72	−0.94
Child is black* computer play	−1.24		−0.82		−0.29		−0.02	

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	Letter word		Passage Comprehension		Applied Problems		Behavior Problems	
Variable	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Child is black* computer communications	5.99 *		8.33 **		−3.23		0.29	
Child is black* video game	−0.56		0.41		−0.66		−0.12	
Computer hours - low to moderate		3.06		4.12 *		3.21†		−1.48
Computer hours - high		12.02		16.50		6.20		−8.86 ***
Video game hours - low to moderate		4.28		0.22		0.45		1.06
Video game hours - high		−11.04 *		0.14		−7.75†		1.93
TV hours - moderate		−7.26		−20.83		−5.60		7.98 **
TV hours - high		0.58		0.52		−1.26		1.35
R^2	0.54	0.55	0.40	0.41	0.50	0.50	0.35	0.34
N	462	462	452	452	459	459	538	538

Note: Data are weighted. Robust standard errors computed using Stata.

*** p< .001,

** p< .01,

* p< .05,

† p<.10

[a] Controls include race/ethnicity, child age in 1997, maternal education, maternal passage comprehension score, number of parents, number of children, ratio of family income to poverty, and the child's test score in 1997

Table 7

Regression Coefficients for Changes in Child Test Scores Associated with Changes in Weekly Media Use between 1997 and 2003

Variable	Letterword	Passage comprehension	Applied problems	Internalizing Problems[a]	Externalizing Problems[a]
			NON-HISPANIC WHITE BOYS[b]		
N	237	228	238	278	278
Change in Weekly Hours in:					
Computer play	0.09	−0.13	−0.24	−0.01	−0.01
Computer study	−0.23	−0.03	−0.33	0.00	−0.03
Computer communications	0.15	−0.27 *	−0.28 *	−0.01	−0.02
Video games	0.00	−0.03	−0.07	0.00	0.01 *
Television	0.13 *	0.01	0.03	0.00	0.00
			BLACK BOYS[b]		
N	185	182	185	195	195
Change in Weekly Hours in:					
Computer play	0.98	0.10	−0.02	−0.03	−0.07
Computer study	0.63	3.71 **	0.17	−0.36	−0.05
Computer communications	0.14	0.95 *	0.53	0.01	−0.02
Video games	−0.09	−0.12	−0.08	0.00	0.01 *
Television	0.10	−0.03	−0.05	0.01	−0.01
			NON-HISPANIC WHITE GIRLS[b]		
N	266	261	265	300	300
Change in Weekly Hours in:					
Computer play	0.55	0.99 *	0.98 **	−0.02 *	−0.01
Computer study	−0.71	0.25	1.18 *	0.05 *	0.01
Computer communications	0.08	0.04	−0.02	−0.01	0.00
Video games	−0.69 *	0.20	0.14	0.02	−0.02
Television	−0.01	−0.02	−0.06	−0.01	0.00
			BLACK GIRLS[b]		
N	179	175	177	188	188

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Variable	Letterword	Passage comprehension	Applied problems	Internalizing Problems[a]	Externalizing Problems[a]
Change in Weekly Hours in:					
Computer play	−0.19	−0.18	−0.28	0.05	0.02
Computer study	0.44	−0.47	−0.48	0.01	0.00
Computer communications	0.38	−0.22	−0.10	0.02	0.00
Video games	0.50	−1.22 **	0.54 *	−0.03	−0.01
Television	−0.04	−0.20 **	−0.01	0.00	−0.01 *

[a] Standardized factor scores with mean of 0 and standard deviation of 1 used here

[b] Controls for change in age of child, number of children, household income, and number of parents.

Note: Data are weighted. Robust standard errors computed using Stata.

*** p< .001,

** p< .01,

* p< .05,

+ p<.10

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Table 8

Effect Sizes for Analyses of Change in Media Use and Change in Test Scores

Test	White boys	Black boys	White girls	Black girls	Race/Gender Interaction
Change in Computer Play and Change in:					
Letter-word Test	0.01	0.08	0.03	−0.01	
Passage comprehension test	−0.01	0.01	0.07 *b	−0.01	*a*
Applied problems test	−0.02	0	0.07 *b	−0.02	*a*
Externalizing behavior problems	−0.01	−0.07	−0.01	0.02	
Internalizing behavior problems	−0.01	−0.03	−0.02 *	0.05	
Change in Computer Study and Change in:					
Letter-word Test	−0.01	0.05	−0.04	0.03	
Passage comprehension test	0	0.27 *b	0.02	−0.03	*a*
Applied problems test	−0.02	0.02	0.09 *b	−0.03	*a*
Externalizing behavior problems	−0.03	−0.05	0.01	0	
Internalizing behavior problems	−0.36	0	0.05 *	0.01	
Change in Computer Communications and Change in:					
Letter-word Test	0.01	0.01	0.01	0.03	
Passage comprehension test	−0.02 *	0.07 *b	0	−0.01	*a*
Applied problems test	−0.02 *	0.05	0	−0.01	
Externalizing behavior problems	−0.02	−0.02	0	0	
Internalizing behavior problems	−0.01	0.01	0.02	0.02	
Change in Video Game Play and Change in:					
Letter-word Test	0	−0.01	−0.04 *b	0.04	*a*
Passage comprehension test	0	−0.01	0.01	−0.08 *b	*a*
Applied problems test	−0.01	−0.01	0.01	0.04 *	
Externalizing behavior problems	0.01 *	0.01 *	−0.02	−0.01	
Internalizing behavior problems	0	0	0.02	−0.03	
Change in Television Viewing and Change in:					
Letter-word Test	0.01 *	0.01	0	0	

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Test	White boys	Black boys	White girls	Black girls	Race/Gender Interaction
Passage comprehension test	0	0	0	−0.01 *	
Applied problems test	0	0	0	0	
Externalizing behavior problems	0	−0.01	0	−0.01 *	*a*
Internalizing behavior problems	0	−0.01	−0.01	0	

*The effect is significant at p<.05.

[a]The effect of this medium on this outcome differs across race/ethnic groups.

[b]This effect is significantly different from that of the comparison group, White boys.